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number of years and the volumes II. to X. (large octavo) are to be published as soon as the manuscript of each is finished, with the assistance of numerous European and American specialists. This work, being thus brought up to date according to modern standards, will be indispensable to all museums and libraries of natural history.

Volume I. will contain the mammalia, by Mr. John A. Wolffsohn, C.M.Z.S., with numerous original illustrations in black and colored plates and photo-engravings in the text.

M. J. R.

NOTE ON THE OCCURRENCE OF HUMAN REMAINS IN CALIFORNIAN CAVES

IN the course of an investigation of some of the limestone caverns in California during the last four years, a number of cases have been noted in which human remains were found in such situations as to indicate that their entombment was not of historically recent date. In no instance have any specimens been discovered which can be said to be of Quaternary age, although some of the occurrences are of such nature that it would be difficult to prove that the remains were buried during the present period.

The writer has already called attention¹ to the occurrence of human remains in Mercer's Cave in Calaveras County, and in the Stone Man Cave in Shasta County, under conditions which certainly suggest a considerable antiquity. In Mercer's Cave a number of human skeletal remains were found in close proximity to the bones of a Quaternary ground-sloth. The bones of both sloth and man were incrustated with a deposit of stalagmite, the incrustation on the sloth bones being considerably thicker than that on the human remains; and it is not probable that they were buried at the same time. It is, however, true that stalagmite deposits may be very uneven, and it is possible that the covering on the ground-sloth was formed in a shorter time than the thinner layer on the human bones.

The remains in Stone Man Cave were dis-

¹ "Recent Cave Exploration in California," *American Anthropologist*, N. S., Vol. 8, No. 2, p. 221.

covered in a remote gallery of this extensive cavern. The greater number of the bones were embedded in a layer of stalagmite which enveloped them to the thickness of one eighth of an inch or more. A vertebra which was obtained many years ago from this locality is found to have lost most of the organic material, and the cavities are largely filled with calcite crystals.

In neither of the cases just described is it possible to fix the age of the remains, but the impression given in both instances is that some centuries have elapsed since the skeletons came into the position in which they were found.

Another interesting occurrence of human bones has recently been brought to the notice of the writer by Dr. J. C. Hawver, of Auburn, California. During the past few years Dr. Hawver has engaged in an energetic exploration of the limestone caves in the vicinity of Auburn, partially at the instance of the University of California, but largely on his own resources. Hawver Cave, discovered by him and recently named in his honor, has been explored and described by Mr. E. L. Furlong,² but Dr. Hawver has continued the exploration of this cavern farther than it was carried by the university. In March, 1908, while attempting to open what Dr. Hawver supposed to be an ancient passageway into the lower cave, a number of human bones were found at a depth of twenty feet below the surface, under a mass of cave earth, fallen rocks and soil, over twelve feet in thickness. The remains lay at the lower end of a passageway which has evidently been closed for a long period. In this case, as in that of Mercer's Cave, remains of extinct animals undoubtedly of Quaternary age were found near the human bones, but the degree of alteration of the unquestionably Quaternary bones differs from that in the human skeletons. Some of the human bones were embedded in a cemented breccia consisting largely of angular fragments of limestone. So far as examined the bones seem to have lost most of their organic matter. A fairly preserved skull in the collection does not differ strikingly from the crania of the

² Furlong, E. L., *SCIENCE*, N. S., Vol. 25, p. 392.

modern California Indians, although no comparative study has yet been made by a specially trained craniologist.

It is not possible in the case of the Hawver Cave relics to prove Quaternary age for the human bones. As in the other instances mentioned, the inference is, however, that the date of their entombment preceded the present day by centuries, if not by millenniums.

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SPECIAL ARTICLES

THE SCIENCE OF EXOTIC MUSIC¹

IF architecture is the king of the fine arts, commanding the outward services of others, music is their queen, imposing the inward laws by which all rule themselves. The notions of harmony, pitch, scale, tonality and key, applied in fine art generally, have in music first become clear enough to receive names. The theory of all the arts awaits to this day the exact grasp of these ideas which the investigation of musical structure will some time give.

¹ A. J. Ellis, "On the Musical Scales of Various Nations," *Journal of the Society of Arts*, XXXIII., 1885. J. P. N. Land, "Ueber die Tonkunst der Javanen," *Vierteljahrsschrift für Musikwissenschaft*, 1889, 1. C. Stumpf, "Lieder der Bellakula Indianern," *Vierteljahrsschrift für Musikwissenschaft*, 1886, 4; "Phonographirter Indianer-melodien" (review of "Zuñi Melodies"), *Vierteljahrsschrift für Musikwissenschaft*, 1892, 1; "Tonsystem und Musik der Siamesen," *Beiträge zur Akustik und Musikwissenschaft*, 3, 1901; "Das Berliner Phonogrammarchiv," *Int. Wochenschrift für Wissenschaft, Kunst und Technik*, 22 Februar, 1908. Franz Boas, "The Central Esquimo," Bureau of Ethnology, Sixth Annual Report, Washington, 1888; "The Kwakiutl Indians," U. S. National Museum, Report for 1895. B. I. Gilman, "Zuñi Melodies," *Journal of American Archeology and Ethnology*, I., Boston, 1891; "Some Psychological Aspects of the Chinese Musical System," *Philosophical Review*, I., Nos. 1 and 2, New York, 1892; "Hopi Songs," *Journal of American Archeology and Ethnology*, V., Boston, 1908. Miss Alice C. Fletcher, "A Study of Omaha Indian Music: With a Report on the Structure of the Music by John C. Fillmore," Peabody Museum, Cambridge, U. S. A., 1893; "The Hako: A Pawnee

Hitherto the study of music has labored under an essential disadvantage compared with that of painting and sculpture. Passing events can not be scrutinized as permanent objects can. Time is lacking for their close determination; and once experienced they become memories only. Precision and revision—twin essentials of science—are possible in observing a combination of color and form, but not of tone. Hence the study of music as we know it is a study of scores. Connoisseurship, pictorial and plastic, has found its material wherever paintings and sculptures exist: musical criticism only where scores exist; that is to say only in modern Europe. In order to bring accurate method to bear on non-European music some means for reproducing it at will is demanded. If we can choose the moment when data of sense are to present themselves we can prepare for their precise registry; and the power to repeat our impressions gives the power to correct them. Such a means has been furnished within our own time and our own country. Chiefly by the aid of the phonograph inquiries into exotic music have within

Ceremony," Bureau of Ethnology, Twenty-second Report, Part 2, Washington, 1903. O. Abraham and E. M. von Hornbostel, "Studien über das Tonsystem und die Musik der Japaner," *Sammelbänder der Int. Musikgesellschaft*, IV., 2, 1903; "Ueber die Bedeutung des Phonographen für vergleichende Musikwissenschaft" and "Phonographierte türkische Melodien," *Zeitschrift für Ethnologie*, XXXVI., 2, 1904; "Phonographierte indische Melodien," *Sammelbänder der Int. Musikgesellschaft*, V., 3, 1904; "Phonographierte Indianer-melodien aus British Columbia," Boas Memorial Volume, New York, 1906. E. M. von Hornbostel, "Phonographierte tunesische Melodien" (1905?); "Notiz über die Musik der Bewohner von Sud Neu Mecklenburg" (1905?); "Ueber den gegenwärtigen Stand der vergleichenden Musikwissenschaft," *Int. Musikgesellschaft*, Basler Kongress, 1906. "Ueber die Musik der Kubu," Städtischer Völkermuseum, Frankfurt, 1908. "Phonographierte melodien aus Madagaskar und Indonesien," Forschungsreise S. M. S. *Planet*, V., 6, Berlin, 1909. Compare also: Charles K. Wead, "Contributions to the History of Musical Scales," U. S. National Museum, Report for 1900. W. C. Sabine, "Melody and the Origin of the Musical Scale," *SCIENCE*, May 29, 1908.